DO LUNAR-LIKE SWIRLS OCCUR ON MERCURY? David T. Blewett[1], Brett W. Denevi[2], Mark S. Robinson[2], and Michael E. Purucker[3]. [1]Johns Hopkins Univ. Applied Physics Lab., 11100 Johns Hopkins Road, Laurel, MD, 20723, USA (david.blewett@jhuapl.edu). [2]School of Earth and Space Exploration, Arizona State Univ., Tempe, AZ 85287, USA. [3]Raytheon/NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA.

Introduction: Lunar swirls are unusual, high-albedo markings found in both the maria and the highlands [1, 2]. These sinuous patches sometimes exhibit dark lanes between bright segments. Swirls have no apparent topographic expression and appear to overprint the surfaces on which they lie. Several origins for lunar swirls have been proposed. These include surface effects produced during relatively recent (<1 My) impacts of meteor swarms [3], a comet coma and nucleus [2], or disrupted comet fragments [4]. Alternatively, the association between swirls and crustal magnetic anomalies has led to the hypothesis that the magnetic anomaly protects the surface from solar wind bombardment [e.g., 5]. Lacking solar wind sputtering and implantation, the swirl has not undergone the normal space weathering (soil-darkening) process to which unshielded areas are subjected [5, 6]. Thus it may be that the presence of a magnetic anomaly preserves a high albedo, even though a magnetically shielded surface would still experience micrometeorite impact. A number of magnetic anomalies are correlated with terranes antipodal to a major impact basin [e.g., 7], and the creation of a crustal magnetic anomaly may involve the amplification of existing magnetic fields by the expanding vapor-melt cloud produced in a lunar basin-forming impact [e.g., 8].

Swirls on Mercury: In their classic paper on the comet-impact origin of lunar swirls, Schultz and Srnka [2] noted that swirl-like markings exist on Mercury. The availability of higher-resolution, higher-quality images from the first two MESSENGER flybys of Mercury [9] now permit us to re-examine the features on Mercury that Schultz and Srnka suggested could be swirls as well as search for additional swirl candidates.

Schultz and Srnka Candidates: The "bright loops and swirls" recognized by Schultz and Srnka [2] are near the craters Lermontov and Handel. Lermontov has a relatively high-albedo floor that contains bright streaks in Mariner 10 images (Fig. 1). MESSENGER Narrow Angle Camera (NAC) images reveal these markings as irregular depressions and small unresolved bright spots (Fig. 2). The high-reflectance floor has an anomalous red color [10]. Elsewhere on Mercury, similar high-reflectance, red material associated with irregular depressions has been interpreted to be of pyroclastic origin [11]. Therefore, the high-resolution MESSENGER data demonstrate that no features resembling lunar swirls are present at this location.

The second Schultz and Srnka location is the crater Handel. As seen by Mariner 10 (Fig. 3), Handel's floor is crossed by a sinuous, diffuse, bright band. The MESSENGER NAC image in Fig. 4 shows that this marking is likely a result of ordinary rays from a small impact crater on the floor and from a nearby crater.

Discussion: Combined Mariner 10 and MESSENGER imaging now covers ~90% of the surface of Mercury. A preliminary survey of MESSENGER NAC images from the first two flybys has not yielded any features with the classic swirl morphology. However, albedo features in the lunar highlands associated with magnetic anomalies may appear as simple, diffuse, bright patches [12]. "Hilly and lineated" terrain located at the Caloris antipode is thought to have been formed by converging seismic waves from the Caloris impact [13]. The area of the antipode is crossed by several bright crater rays, which together with the unusual texture of the terrain potentially makes recognition of anomalous albedo markings difficult. Such areas can be imaged with differing viewing geometry and higher spatial resolution during the MESSENGER orbital phase.

If the magnetic shielding hypothesis for the origin of lunar swirls is correct, then several factors make it less likely that swirls of the same kind would exist on Mercury. First, MESSENGER Magnetometer data from the first two flybys have not definitively revealed the presence of crustal magnetic anomalies on Mercury [14]. Second, even if crustal anomalies are present, Mercury's global magnetic field should stand off the solar wind at most times, with a crustal anomaly only adding marginally to protection of the surface from solar wind bombardment. Therefore the differential space weathering attributed to local magnetic anomalies on the Moon would not occur. Thus the apparent lack of swirl features on Mercury favors the solar-wind shielding hypothesis for the origin of lunar swirls. This has important implications for the agent of space weathering [e.g., 15], and suggests that solar wind sputtering and implantation play a greater role than micrometeorite bombardment.

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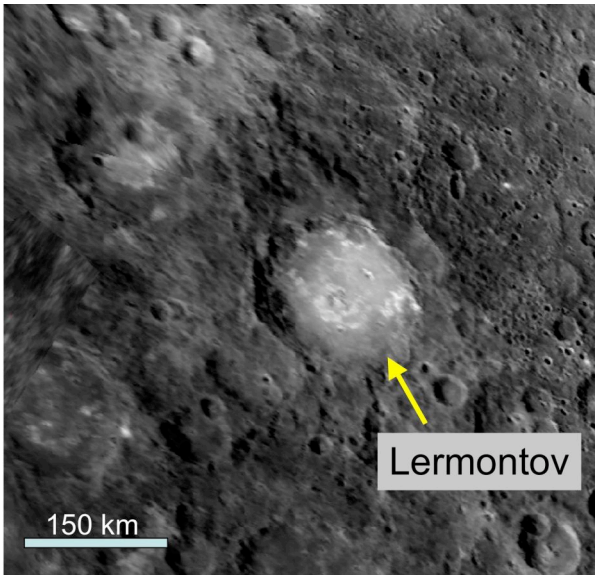

Figure 1. Mariner 10 clear-filter image of Lermontov (crater center at ~15°N, 311°E), 1 km/pixel.

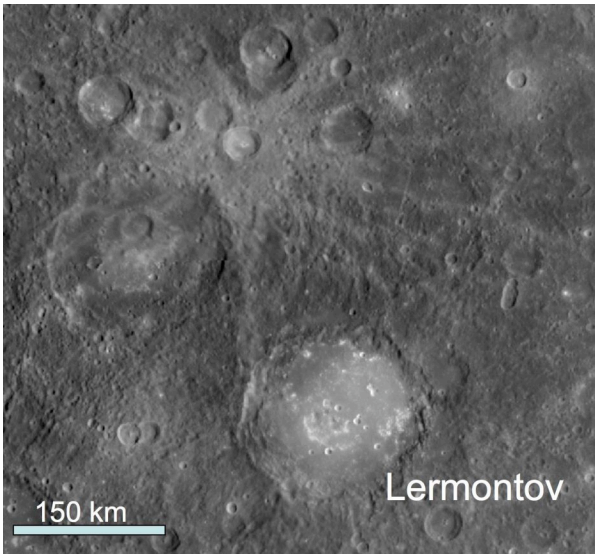

Figure 2. MESSENGER NAC image (~250 m/pixel, center near 18.1°N, 310.5°E) of Lermontov.

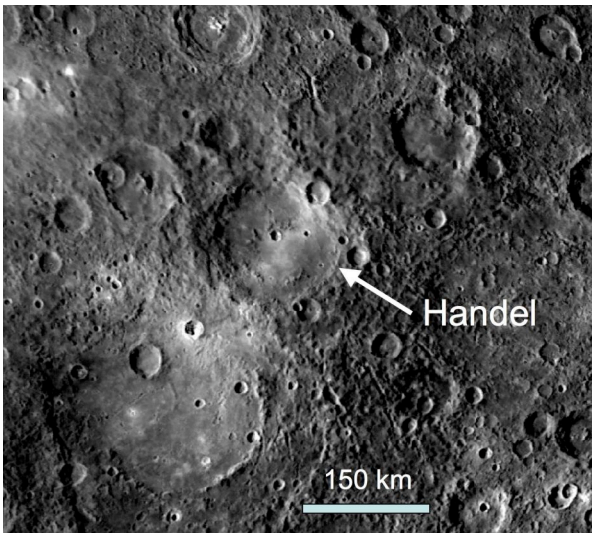

Figure 3. Mariner 10 clear-filter image of Handel (crater center at ~4°N, 325°E), 1 km/pixel.

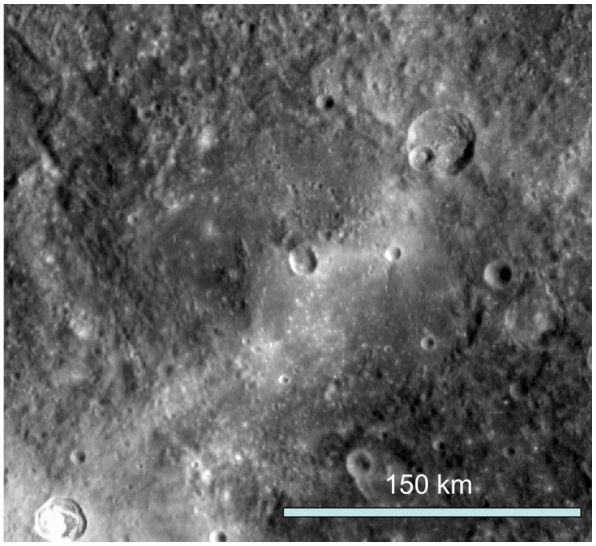

Figure 4. MESSENGER NAC image (~250 m/pixel, center near 3.8°N, 325.9°E) of Handel.

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